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## SYSTEM AND METHOD FOR MODIFYING ELECTRICAL CHARACTERISTICS

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### Field Of The Invention

The present invention generally relates to systems and methods that modify electrical characteristics.

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### Background Of The Invention

Handheld wireless communications devices often employ, for example, quarter-wave transformers for cellular, personal communications services (PCS) or global positioning system (GPS) frequency bands. Such quarter-wave transformers, when not adapted, are typically much longer than can be easily accommodated by most handheld wireless communications devices.

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In order to reduce the length of such quarter-wave transformers, a block 20 of dielectric material is used as shown in FIG. 3. FIG. 3 shows a trace 10 that has been printed on a circuit board 50. The trace 10 is not continuous as a space was provided onto which the dielectric block 20 could be mounted. The dielectric block 20 already has a trace 40 printed on its surface across three faces of the block 20. The dielectric block 20 must be carefully aligned when it is mounted to avoid any discontinuities at point 30 between trace 10 of the

board 50 and trace 40 of the block 20. If successful, the dielectric block 20 modifies the electrical properties of the trace 10, 40 such that a shorter trace can be used for a quarter-wave transformer, for example.

As is evident from FIG. 3, there is very little room for error concerning the proper alignment of the traces 10, 40. Not only must the traces 10, 40 be connected, but they must be well aligned since misaligned (albeit connected) traces 10, 40 provide variances from the expected electrical characteristics of the trace 10, 40 which can have deleterious effects on the handheld wireless communications device, especially during mass production.

In addition, since the block can only be mounted in one way, that is, with the traces 10, 40 aligned and connected, there is no easy way in which to modify the electrical characteristics of the trace 10, 40 in situ. Thus, a degree of flexibility is lost especially in light of the variability of the electrical characteristics of the traces 10, 40.

Accordingly, there exists a need for a method and a system of modifying the electrical characteristics of a trace that provide robust, well-aligned trace connections and also provides flexibility to change electrical properties in situ.

### Summary Of The Invention

The present invention alleviates to a great extent the disadvantages of conventional apparatus and methods for providing a multiband antenna.

In a preferred embodiment, the present invention provides an electrical component disposed on a circuit board and a dielectric material. The electrical component has an electrical parameter that is sensitive to a dielectric constant of a substance proximate to the electrical component. The dielectric material is attached to the circuit board proximate to

the electrical component and modifies the electrical parameter of the electrical component.

The present invention has an advantage in that the dielectric material is not required to complete the electrical component. Accordingly, problems such as alignment and continuity of the electrical component are reduced, if not eliminated.

5       The present invention also has an advantage in that the electrical properties of the electrical component can be modified, *in situ*, by placing the dielectric material in a different position or a different orientation relative to the electrical component.

These and other features and advantages of the present invention will be appreciated from review of the following detailed description of the present invention, along with the  
10      accompanying figures in which like reference numerals refer to like parts throughout.

#### Brief Description Of The Drawings

FIG. 1A shows a perspective view of a dielectric block mounted on top of a trace according to the present invention;

15      FIG. 1B shows a top view of the dielectric block mounted on top of a trace according to the present invention;

FIG. 2A shows a top view of the dielectric block mounted at a particular displacement from the trace according to the present invention;

FIG. 2B shows a top view of the dielectric block attached to a circuit board via adhesive dots according to the present invention; and

20      FIG. 3 shows a conventional arrangement between a dielectric block and a trace.

### Detailed Description Of The Invention

FIGS. 1A and 1B illustrate an exemplary embodiment of a dielectric material 70 disposed on top of a trace 60 according to the present invention. The trace 60 may be printed or deposited on the circuit board 50. Subsequently, the dielectric material is mounted or  
5 deposited on top of trace 60.

Such a system may find application in wireless communications devices, for example, for use in a quarter-wave transformer. However, the present invention is not so limited and contemplates uses in any application in which the electrical properties may be modified or optimized. For example, the trace may be part of an antenna, an inductor, a  
10 capacitor, a resonating structure, transmission lines, wave-guides, etc. In addition, although illustrated as using a trace, the present invention contemplates using other electrical components known to one of ordinary skill in the art.

Since there is only the one trace 60, there are no trace-to-trace continuity and alignment problems which might affect the electrical characteristics of the trace. In addition,  
15 since the disposition of the dielectric material 70 with respect to the trace 60 affects the electrical properties of the trace 60, the dielectric material 70 can be mounted in different orientations and positions with respect to the trace 60 to optimize the expected electrical properties of the trace 60.

For example, FIG. 2A shows the dielectric material 70 that has been displaced, for  
20 example, along a direction that is perpendicular to the axis of the trace 60. The trace 60 illustrated in FIG. 2A has different electrical properties than the trace 60 illustrated in FIG. 1B. Furthermore, although FIG. 2A illustrates a particular displacement and orientation of the dielectric material 70 with respect to the trace 60, it is understood that there are a wide

variety of displacements and orientations of the dielectric material 70 from which to choose to provide additional degrees of freedom in optimizing or achieving particular electrical properties of the trace 60.

FIG. 2B illustrates that adhesive dots 80 mounted on the circuit board 50 may be used 5 to hold the dielectric material 70 to the circuit board 50. Accordingly, the dielectric material 70 can easily be attached and detached from circuit board 50. Thus, in attempting to achieve an optimized or particular electrical property of the trace 60, the dielectric material 70 can be displaced or reoriented and easily mounted or dismounted from the circuit board 50. With each mounting of the dielectric material 70, the trace 60 could be tested to see if the 10 particular electrical property had been achieved or optimized. Thus, for example, the trace 60 can be optimized for cellular band frequencies when the dielectric material 70 is in a first orientation and position, while the trace 60 can be optimized for PCS band frequencies when the dielectric material 70 is in a second orientation and position.

Although illustrated as adhesive dots 80 mounted on the circuit board 50, other types 15 and shapes of adherents may be used to attach and to detach the dielectric material 70. For example, physical hooks or receptors could be mounted on the circuit board 50 in order to hold the dielectric material 70 on the circuit board 50. In addition, the adhesive dots 80 may be disposed on the dielectric material 70 instead or in addition to the adhesive dots 80 on the circuit board 50. FIG. 2B also illustrates an example of adhesive pads 90 on the dielectric 20 material that can be used to attach the dielectric material to the circuit board 50.

In addition, although the dielectric material 70 has been illustrated as a block, the dielectric material 70 can take on any number of shapes and forms. Moreover, although the trace 60 has been illustrated as a line trace, other shapes and forms of the trace 60 known in

the art are also contemplated. In addition, the particular choices available for materials for use in the dielectric material 70 and the trace 60 are well known in the art.

Although the dielectric material 70 has been illustrated as being on top of the trace 60, the dielectric material 70 could equally be mounted under the trace 60. For example, the  
5 trace 60 could be disposed on a first side of the circuit board 50 and the dielectric material 70 could be disposed on the second (opposite) side of the circuit board 50.

Finally, although the dielectric material 70 has been illustrated in contact with the trace 60, the dielectric material 70 may be in contactless proximity of the trace 60. Such contactless proximity can still affect the electrical properties of the trace 60.

10 Thus, it is seen that systems and methods for modifying electrical properties have been described. One skilled in the art will appreciate that the present invention can be practiced by other than the preferred embodiments which are presented in this description for purposes of illustration and not of limitation, and the present invention is limited only by the claims that follow. It is noted that equivalents for the particular embodiments discussed  
15 in this description may practice the present invention as well.